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**PREFERENTIAL REGULATORY TREATMENT AND BANKS'
DEMAND FOR GOVERNMENT BONDS**

By

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Preferential Regulatory Treatment and Banks' Demand for Government Bonds

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Abstract

The purpose of this paper is to analyze the impact of preferential regulatory treatment on banks' demand for government bonds. Using unique transaction-level data, our analysis suggests that preferential treatment in microprudential liquidity and capital regulation significantly increases banks' demand for government bonds. Liquidity and capital regulation also seem to incentivize banks to substitute other bonds with government bonds. We also find evidence that this "regulatory effect" leads banks to reduce lending to the real economy.

Keywords: Government bonds, financial markets, regulation, liquidity, capital

JEL classification: G18, G21, E42

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1. Introduction

European banks hold sizeable shares of government debt securities.¹ Popov and van Horen (2013) argue that the 0% risk weight in the context of capital regulation is a key driver of banks' holdings of government bonds. Besides capital regulation, government debt securities also receive preferential treatment in the newly proposed Basel III liquidity requirements as well as in the context of regulatory efforts to limit large exposures to individual countries and counterparts.² While they also bring forward the argument of preferential regulatory treatment, Gennaioli et al. (2013) formulate two more hypotheses explaining banks' holdings of government bonds. The first one follows a large stream of literature arguing that banks hold government bonds as source of liquidity and collateral making them operating more effectively during normal times but not necessarily during stress.³ The second hypothesis follows Acharya and Steffen (2013) and is based on the idea that banks hold lower quality government bonds, allowing them to gain from preferential regulatory treatment but at the same time secure high returns. A further reason was brought forward by Farhi and Tirole (2014), who argue that banks hold domestic government bonds to increase the likelihood of public support.

The focus of this paper is the first argument, and specifically the question whether financial regulation increases banks' demand for government bonds (henceforth "regulatory effect") or rather whether banks' government bond holdings are driven by other factors (henceforth "internal effect"), such as the ones brought forward by Holmstroem and Tirole (1993), Acharya and Steffen (2013) and Farhi and Tirole (2014).⁴

Especially the European sovereign debt crisis raised concerns regarding the vicious

¹ See, for instance, EBA (2013a).

² See BCBS (2010a,b, 2013) as well as EU No 575/2013 ("CRD IV").

³ See, for instance, Gennaioli et al. (2014) or Holmstroem and Tirole (1993).

⁴ It is likely that several of these factors jointly play a role in banks' decision-making processes.

circle between weak bank balance sheets and sovereign fragility.⁵ A possible way to break this vicious circle is to reduce the attractiveness of government bonds in financial regulation.⁶ In line with this, the Basel Committee on Banking Supervision stated in a recent report to the G20 leaders that it will review the current regulatory treatment of sovereign risk and consider possible policy options.⁷ To arrive at sound solutions, however, we first need to understand whether financial regulation is truly a key driver of banks' government bond holdings.⁸

The correlation between banks' funding and liquidity needs (or other incentives) and their compliance with regulatory requirements poses a challenge to establishing a causal link from the various incentives for banks to hold government bonds and their actual holdings. To distinguish whether a change in banks' government bond holdings is caused by regulation or by other factors, we need detailed information on banks' targets used in their internal risk management frameworks.

Since such data is not available in a structural form, an alternative approach is to distinguish whether the proximity of a bank to its regulatory liquidity and capital thresholds changes its demand for government bonds during the entire following month or only around the monthly reporting date. The hypothesis is that if banks' regulatory capital and liquidity positions change their demand for government bonds over the entire next month, it cannot be established whether this is caused by internal or regulatory effects. However, a change in demand only around the reporting date points towards the presence of a regulatory effect.

⁵ See, for instance, Brutti and Saure (2013), Acharya and Steffen (2013), Gennaioli et al. (2014) or Farhi and Tirole (2014).

⁶ Alternatively, one could also require banks to significantly increase their capital and liquidity levels.

⁷ See BCBS (2015).

⁸ The main criticism of the current regulatory treatment of government bonds is that government bonds of an institution's home jurisdiction get the most favorable treatment across most regulatory frameworks, independent of their riskiness. See also Weidmann (2013) and Buch et al. (2013).

Using unique transaction-level data obtained from the Markets in Financial Instruments Directive (MiFID) database for 17 banks from June 2009 to December 2012, this paper attempts to distinguish regulatory from internal effects and aims to answer the question whether microprudential capital and liquidity regulation increases banks' demand for government bonds beyond their own risk appetite, leading banks to substitute other types of bonds with government bonds.

Due to the presence of long-running liquidity and capital requirements in the Netherlands, it is possible to assess the impact of both requirements, allowing to draw the link to Basel III. The Seemingly Unrelated Regressions (SUR) suggest that liquidity and capital requirements cause banks' demand for government bonds to increase beyond their internal risk management targets. The relative preferential treatment seems to cause a substitution effect, with banks buying government bonds while selling other bonds. We also find suggestive evidence that this regulatory effect reduces banks' lending to the real economy.

When drawing policy implications from these results, it is important to note that the purpose of this paper is to analyze whether financial regulation increases banks' demand for government bonds and whether this effect has an adverse impact on the real economy. While the paper provides new insights into these dynamics, it does not comprehensively answer the question whether increased government bond holdings are desirable. However, the analysis confirms that, if policymakers wish to break the vicious circle between weak governments and weak banks, changing financial regulation appears to be a good starting point.

2. Background

This section provides general background regarding the hypothesis as well as the key variables underlying our analysis. Section 2.1 provides information on data sources and

variable construction. Most importantly, the section discusses the MiFID dataset and introduces the dependent variable of the main regression analysis in this paper. The variable describes banks' net purchases of government bonds and other bonds over the course of the month.

Although the focus of this paper is banks' demand for government bonds, Section 2.2 discusses the evolution of banks' government bond holdings from 2004 to 2012. Section 2.3 explains the regulatory treatment of government bonds in microprudential liquidity and capital regulation and introduces the key explanatory variables of our econometric analysis. It also discusses the development of banks' liquidity buffers and capital levels in recent years and how binding the requirements were during the period from June 2009 to December 2012. Section 2.3 also shows that both, capital and liquidity requirements, are binding from time to time for the majority of institutions.

Section 2.4 presents some descriptive statistics regarding banks' government bond purchases. The data suggests that, on aggregate, banks' net purchases of government bonds are relatively stable during the course of the month. Section 2.4 does not yet discuss the impact of banks' regulatory capital and liquidity positions on their net purchases, which is the purpose of the subsequent regression analysis. Section 2.5 provides summary statistics.

2.1. Data Sources

To analyze the impact of regulatory treatment in microprudential liquidity and capital regulation on banks' demand for government bonds, this paper brings together data on 1) bilateral transactions of Dutch bonds between Dutch banks; 2) banks' regulatory liquidity and capital positions; 3) risk indicators and other measures calculated from the balance sheet, as well as 4) macroeconomic factors.

The primary data source of this paper are the MiFID transaction reports obtained from

the Netherlands Authority for the Financial Markets (AFM). The MiFID was introduced as part of the EU financial market integration in November 2007 with the purpose to regulate the provision of financial instruments and to clarify the responsibilities and powers of national competent authorities regarding these activities.⁹ Articles 25(3) and (4) of MiFID require financial institutions to report trading activities for any instrument admitted to trading on regulated venues. As such, the MiFID database is the most comprehensive dataset on bond transactions in the EU.¹⁰

The MiFID database covers June 2009 to December 2012. Along with a large amount of other information, each transaction includes the International Securities Identification Number (ISIN) of the traded security, the two counterparts, volume, time to maturity, the exact time as well as whether the reporting institution acted as a buyer or a seller. After cleaning and consolidating the data, we use the transaction reports to construct the total daily purchases and sales per consolidated entity, distinguishing government bonds from all other bonds.¹¹ The dependent variable of our regression analysis, banks' daily net purchases of government bonds and other bonds, is calculated as the difference between institution i 's gross purchases and gross sales of bond b (government bonds or other bonds) as a percentage of its average daily gross purchases during the year. Government bonds only include Dutch government bonds, while other bonds include all bonds issued by Dutch entities other than the Dutch government. Other bonds therefore include all covered bonds, corporate bonds as well as securitizations issued by Dutch institutions. It does not include government bonds issued by other countries than the Netherlands or other non-Dutch institutions.¹²

⁹ Directive 2004/39/EC.

¹⁰ See EBA (2013b), which provides evidence for the comprehensive coverage of the database. Note though that we only have data on transactions of securities issued by Dutch (financial) institutions.

¹¹ For more information on data cleaning, please see the Appendix.

¹² Please note that we do not have data on securities issued by non-Dutch institutions.

The regulatory liquidity data stems from banks' monthly reporting of the Dutch liquidity requirement (DLCR). Since the DLCR applies to all banks, clearing as well as settlement institutions, and only a few waivers apply to foreign branches, all banks in our sample are subject to the requirement. For the purpose of this analysis, we calculate the distance of banks' DLCR to the regulatory threshold. The capital ratio is taken from banks' reporting in the context of Basel 2.5 (quarterly) in combination with monthly monitoring reports.¹³

Since it plays an important role in the context of adjusting to regulation and the decision to hold government bonds, we additionally obtained data on banks' net income as a percentage of total assets and banks' return on equity (net income as a percentage of total capital). Another bank-specific variable is banks' lending to households and non-financial corporations as a percentage of total assets. The bank-specific data is taken from DNB's prudential reporting. Our bank-specific variables also include the growth rate of the DLCR's denominator, which is intended to capture the evolution of banks' liabilities, as well as an institution's fulfilment of the average reserve requirement. All bank-specific variables are reported monthly.

As macroeconomic variables, the analysis includes the EONIA interest rate, the quarterly GDP growth rate of the Netherlands, total government debt over total GDP of the Netherlands, as well as the relative rating of the Netherlands compared to its peers (Germany, Finland, France, Austria and Belgium).¹⁴ With the exception of the relative rating, which

¹³ According to law, the microprudential liquidity requirement entails a monthly reporting requirement, while the capital requirement has to be reported only quarterly. However, in the additional supervisory rules, it is specified that both requirements have to be fulfilled on an on-going basis and have to be monitored (and reported) at least monthly. For both requirements, the reference date is the last day of each month, while the reporting date is a few days after that.

¹⁴ To calculate the relative rating, all country-specific ratings are converted to numeric values (AAA=1). The Netherlands' rating is then divided by the average rating of its peers. In case a country is put on "negative watch", the rating is reduced by 0.5.

comes directly from the S&P database, all macroeconomic variables are retrieved from the ECB's statistical data warehouse.

2.2. Government bond holdings from 2004 to 2012

Although the paper focuses on banks' purchases and sales of government bonds, it is useful to first have a look at how banks' holdings of government bonds have evolved in recent years. Figure 1 shows the evolution of banks' government bond holdings from 2004 to 2012. The vertical lines represent the start (June 2009) and end date (December 2012) of the MiFID dataset.

[Insert Figure 1 here]

The DLCR and includes all government bonds with a 0% risk weight under the Basel II Standardized Approach. On average, Dutch government bonds comprise around 40% of banks' total government bond holdings, closely followed by German government bonds. Many Dutch banks also hold some Belgian, French and very small amounts of Southern European bonds.¹⁵

As can be seen from Figure 1a, in 2004 banks' average holdings of high quality government bonds amounted to about 12%, while median holdings were just above 8%. Apart from some smaller spikes, banks' government bond holdings declined relatively steadily until the outbreak of the financial crisis in September 2008. As typical during financial crises, government bonds rose between September 2008 and September 2009 from just above 8% to almost 12.5%. In October 2009, Greece announced that it had significantly underreported its budget deficit. After this announcement, which is often seen as the be-

¹⁵ For more information on European bond holdings, please see the European Central Bank's statistical report on "Debt securities issuance and servicing by EU governments".

gining of the European sovereign debt crisis, banks seem to significantly reduce their exposure to governments. While average holdings stabilized in the course of 2011, median holdings show another sharp reduction, suggesting that there are a number of banks that seem to have maintained larger amounts.

As presented in Figure 1b, government bond holdings in liquid assets show a similar pattern, meaning a rather steady decline until the financial crisis, followed by a sharp increase, which is reversed in response to the sovereign debt crisis. The sharp increase of government bond holdings in liquid assets in May 2011 is due to a revision of the liquidity rule, which increased the haircuts of all securities. However, the haircuts of government bonds were only increased by 5%, while most other assets were subject to haircut increases of about 30%. The revision made the rule stricter but increased the relative attractiveness of government bonds.

2.3. *Government bonds in regulatory frameworks*

While national capital requirements date back even further, the implementation of Basel I in 1992 harmonized capital regulation across the globe. Since then, both the definition of eligible capital and the risk weights (RW) of an institution's assets have been subject to several changes. The most recent development is the Basel III accord and its implementation in national legislation.¹⁶

To understand the interaction of capital requirements and government bond holdings, it is useful to begin with a closer look at the calculation of regulatory capital ratios:

$$\text{Capital requirement} = \frac{\text{Total capital}}{\text{Risk weighted assets (RWA)}} \geq 8\% \quad (1)$$

¹⁶ See BCBS (2010b) and EU No 575/2013 ("CRD IV").

Since our dataset covers June 2009 to December 2012, the Basel 2.5 definition of capital is applicable. Total capital therefore consists to at least 50% of Tier 1 capital (equity capital and disclosed reserves) complemented by undisclosed reserves, revaluation reserves, general provisions and loan-loss reserves, hybrid debt capital instruments, as well as some subordinated debt (Tier 2). Capital requirements are reported quarterly while monitoring takes place on a monthly basis.

As can be seen, the denominator of the capital requirement is determined by multiplying the notional amounts of an institution's assets by their respective RW. Thus, if an institution holds an asset with a 20% RW, it needs to hold capital amounting to at least 8% (the minimum capital ratio) of the notional amount of the respective asset multiplied by 20%. Due to their 0% RW, foreign government bonds rated AAA to AA- or any domestic government bond do not require banks to hold any capital, making government bonds relatively more attractive.¹⁷ To increase its capital ratio, a bank can therefore either raise capital or reduce its RWA. While banks are able to raise capital in the short run, adjustment costs usually make them hesitant to do so.¹⁸ To reduce their RWA, banks can either reduce lending or sell securities. However, since the majority of banks' loans have long maturities, compressing the loan portfolio is often difficult. As institutions need sufficient securities for funding purposes, only selling large amounts of securities with high RW is not realistic either. As such, the seemingly easiest way to address a short-term capital shortcoming is to substitute bonds with high RW by government bonds.

¹⁷ Usually government bonds have lower yields than other securities. Under normal circumstances institutions balance the gains from holding government bonds (safe asset, preferential regulatory treatment) with the opportunity costs of doing so (lower return). During the sovereign debt crisis, bonds issued by European peripheral countries had very high yields while banks could still gain from preferential regulatory treatment.

¹⁸ It is sometimes argued that more capital reduces banks' return on equity, which in turn determines the dividends their shareholders receive. Existing shareholders are therefore said to have an incentive to avoid capital increases. However, according to Admati et al. (2014) these arguments are flawed because raising more equity makes the bank less risky and therefore reduces its funding costs.

Turning to liquidity regulation, we can see similar dynamics. As proxy for the Basel III Liquidity Coverage Ratio (LCR) we use the Dutch liquidity requirement (DLCR), which was introduced in July 2003 and revised in May 2011.¹⁹ The LCR and the DLCR are very similar in their design and are both based on classic liquidity "coverage" considerations. Both ratios are reported monthly and require banks to hold an amount of high quality liquid assets to cover their net cash outflows over a 30 day stress scenario. The DLCR is defined as follows:

$$DLCR = \frac{\text{Actual Liquidity}}{\text{Required Liquidity within 30 days}} \geq 100\% \quad (2)$$

Actual Liquidity (AL) is calculated as the sum of liquid assets minus haircuts plus contractual cash inflows weighted by degree of liquidity. AL includes cash, government bonds as well as central bank eligible covered bonds, corporate bonds and securitizations. The DLCR is reported monthly. Required Liquidity (RL) is a combination of assumed calls on off-balance sheet items (e.g. committed credit facilities) and withdrawals of deposits.

Compared to the LCR, the DLCR has a wider definition of liquid assets but applies higher haircuts. For instance, the DLCR has a wider definition of eligible securitizations. However, all securitizations are subject to a haircut of 50%, as opposed to the 25% haircut applied in the LCR. The DLCR is somewhat stricter regarding the outflow assumptions of banks' liabilities. Retail deposits, for instance, receive outflow rates between 10% and 20% in the DLCR, but between 3% and 10% in the LCR. On aggregate, the differences between the LCR and the DLCR are insignificant. In this sample, 92% of the observa-

¹⁹ For legal background on the DLCR, please refer to DNB (2003). For two recent papers, please refer to Bonner and Eijffinger (2015) or De Haan and van den End (2013).

tions show joint (non-)compliance with the LCR and DLCR. The correlation coefficient is 86%.²⁰

An important difference between the two ratios is the treatment of government bonds, especially in light of the DLCR's revision in May 2011. Before May 2011, government bonds were subject to a haircut of 5%, compared to 20% of most other bonds. The revision in May 2011 increased the haircuts of government bonds to 10% while the haircuts of most other bonds increased to 50%.²¹ Apart from covered bonds, which retained their haircut of 20%, all bonds issued by corporates or banks were subject to haircut increases to 50%.²² The revision in May 2011 made government bonds therefore relatively more attractive from a regulatory point of view. This difference between the LCR and the DLCR implies that the potential impact is even bigger for the LCR.

Similar to capital, an institution can steer its DLCR by either increasing its AL or by reducing its RL. Again, however, reducing liabilities seems to be a less feasible option than increasing liquid assets. Buying government bonds appears to be the most efficient strategy to correct a DLCR deficiency.

[Insert Figure 2 here]

Figure 2 shows the evolution of the components of both the DLCR and the capital requirement. Figure 2a shows that banks' available and required liquidity are quite closely correlated. According to recent evidence by Banerjee and Hio (2014), banks mainly ad-

²⁰ See the Appendix for a table comparing the two standards.

²¹ For more details, see <http://www.toezicht.dnb.nl/en/2/51-201890.jsp> and <http://www.toezicht.dnb.nl/en/2/51-201842.jsp>.

²² Covered bonds have a very similar structure to securitizations and are most commonly backed by mortgages. In contrast to securitizations (which are moved to a Special Purpose Vehicle (SPV)), covered bonds remain on the issuer's balance sheet. For more information, see EBA (2013b).

just their asset side in response to liquidity regulation. Banks' liquidity buffers steadily increased from 2004 until the beginning of the financial crisis in 2008, when buffers began to decline. A particularly sharp decline can be observed immediately after the failure of Lehman Brothers in October 2008. The sharpest spike can be observed after the revision of the liquidity rule in May 2011, when available liquidity sharply declined.

Turning to Figure 2b, we can observe relatively high correlation between capital and RWA before 2008, when capital continued to increase, while RWA declined. The decline of RWA is likely caused by banks having to write off significant shares of their loans.

Since we are interested in the impact of capital and liquidity regulation on banks' demand for government bonds, it is important to understand how binding the requirements are. Figure 3 shows the distribution of the DLCR and capital requirement per bank over the period from June 2009 to December 2012.

[Insert Figure 3 here]

Figure 3a shows that the DLCRs of most banks range between 100% and 200%. Most of these banks have several observations close to the regulatory threshold of 100%, some even below that. Figure 3b points towards a similar pattern, showing that the capital ratios of most banks lie between 10% and 20%.

Berger et al. (2008) show that banks tend to maintain a (precautionary) capital buffer above the regulatory threshold to avoid supervisory penalties.²³ On top of that, most

²³ Non-compliance with the requirements in our sample will cause immediate action by the supervisor. Should a bank breach the liquidity or capital requirement, the bank must immediately increase its reporting frequency, explain the reasons for non-compliance and is required to communicate a plan on how it intends to become compliant again. If the bank fails to adhere to the agreed plan, it will have to pay a fine that is calculated as a function of current interest rates and the detected shortfall. It is sometimes argued that non-compliance leads to an immediate implicit fine (e.g. the costs for increasing the reporting frequency, formulating a plan, etc.) and possibly an explicit fine.

banks in the Netherlands are subject to additional Pillar 2 capital and liquidity requirements. Against this background, it is likely that even holdings above the regulatory minimum are binding.

There are, however, three banks in the sample with DLCRs that are constantly above 200% and one bank with the majority of observations above 200%. Since the DLCR is not binding for these banks (even taking into account precautionary and Pillar 2 buffers), there is the chance that they act differently. Similarly, there are two banks with capital ratios that are constantly above 20% and one with the majority of observations above 20%. To avoid biases in this regard, the regression analysis includes two dummies. The first dummy is 1 in case the DLCR is above 200% and 0 otherwise; the second dummy is 1 in case the capital ratio is above 20% and 0 otherwise.

2.4. Banks' net purchases

Since the purpose of this paper is to distinguish regulatory from internal effects, it is important to understand banks' trading patterns throughout a month. Figure 4 shows banks' average net purchases of government bonds (Figure 4a) and other bonds (Figure 4b) over windows consisting of 10 days, as well as the corresponding number of observations. Banks' net purchases are calculated as the difference between institution i 's gross purchases and gross sales of bond b (government bond or other bonds) as a percentage of its average daily gross purchases during the year.²⁴ The number of observations corresponds with the total number of trades executed by banks that are active as a buyer or a seller at least once every day. Day 12, for instance, refers to banks' average net purchases between day 3 and day 12.

²⁴ The idea behind calculating the variable that way is that it allows us to detect extraordinary portfolio adjustments and that we tried to avoid scaling the dependent variable with a variable from a different dataset (due to different levels of consolidation). Also see Section 6.

Figure 4a shows that banks' net purchases of government bonds are fairly stable and only show a slight downward slope towards the end of the month. The average over the entire month is 23%, with 20% and 24% being the minimum and the maximum, respectively. A similar pattern can be observed for the number of observations. An important takeaway from Figure 4a is that on aggregate banks do not seem to increase but rather decrease their demand for government bonds towards the reporting date.

[Insert Figure 4 here]

Figure 4b shows that, similar to government bonds, banks' net purchases of other bonds are stable during the course of the month. The average over the entire sample is 8%, with the maximum and minimum being 6% and 10%, respectively. In contrast to government bonds, banks' net purchases of other bonds somewhat increase towards the end of the month. The data does not suggest the presence of a general regulatory effect with all banks buying more government bonds while selling more other bonds immediately before reporting.

2.5. *Summary statistics*

The analysis in this paper includes 17 Dutch banks. The constructed variables based on the MiFID transaction reports represent daily observations per bank. Apart from the daily fulfilment of the average reserve requirement, all bank-specific variables are reported monthly, while the macroeconomic variables (apart from EONIA and the relative rating of the Netherlands) are reflected by quarterly observations. The dataset is a balanced panel, implying that there is no bank with missing observations. The 17 banks comprise more than 99% of total banking sector assets and more than 95% of total lending. Four of the 17 banks use the internal-rating-based approach (IRB) to calculate risk weights for

government exposures. However, the average risk weight of these banks for sovereign bonds amounts to less than 3% and is therefore not significantly higher than the 0% of the Standardized Approach.²⁵ The average size (natural logarithm) of the banks in the sample is 17.84. Banks' net income is about 1.23% of total assets, while banks' return on equity amounts on average to 4.92% (monthly).

[Insert Table 1 here]

3. Methodology

3.1. The model

The baseline regression takes the following form:

$$\begin{aligned}
 Net\ Purchases_{i,b,d} = & \beta_0 + \beta_1(Capital\ buffer)_{i,m-1} \\
 & + \beta_2(Liquidity\ buffer)_{i,m-1} + \beta_3(Revision)_{m-1} + \beta_4(Liquidity\ buffer * Revision)_{i,m-1} \\
 & + \beta_5Controls_{(i,b,d),m(-1)} + \epsilon_{i,m}
 \end{aligned} \tag{3}$$

where $Net\ Purchases_{i,b,d}$ refers to the difference between institution i 's gross purchases and gross sales of bond b (government bonds or other bonds) on day d as a percentage of its average daily gross purchases during the year.

$Capital\ buffer_{i,m-1}$ refers to the difference between an institution's capital ratio in month $m-1$ and the regulatory threshold of 8%. Similarly, $Liquidity\ buffer_{i,m-1}$ de-

²⁵ Please also note that, since regulators have to approve banks' IRB models, it is likely that government bonds receive a similar preferential treatment in this regard.

scribes the distance of an institution's actual liquidity position in month $m-1$ from its regulatory threshold of 100%. Defining the ratios that way ensures that the intercept reflects the value of the regression function at the regulatory threshold.²⁶ As explained earlier, the DLCR was revised in May 2011, making government bonds relatively more attractive. $Revision_{m-1}$ is a dummy, which is 1 after the revision and 0 otherwise. $(Liquidity\ buffer * Revision)_{i,m-1}$ reflects the interaction term of the two variables.

As discussed in Section 2.3, purchasing more government bonds while selling other types of bonds is a possible strategy for banks to address a regulatory liquidity or capital shortage. Against this background, we expect negative coefficients for $Liquidity\ buffer_{i,m-1}$ and $Capital\ buffer_{i,m-1}$ regarding government bonds (implying that banks with higher regulatory liquidity and capital levels purchase fewer government bonds on a net basis) and positive coefficients for other bonds (pointing to banks with higher regulatory positions to purchase more other bonds on a net basis). In the presence of a regulatory effect, we expect these coefficients to only be significant closer to reporting. Since the revision of the liquidity rule made government bonds relatively more attractive, it is expected that it reinforces the mentioned effect.

$Controls_{(i,b),m(-1)}$ includes a combination of macroeconomic, bond-specific (b) and other bank-specific (i) variables in month m (for the macroeconomic and bond-specific variables) or $m-1$ (for the other bank-specific variables) and day d (only for the reserve requirement). The additional bank-specific control variables include an institution's profitability (net income as a percentage of total assets), return on equity (income as a percentage of total equity) and total private sector lending as a percentage of total assets. As argued by Delechat et al. (2012), it is easier for more profitable banks to fund themselves. Those banks are therefore more likely to look for alternative, more profitable

²⁶ See, for instance, Lee and Lemieux (2010).

funding sources to correct a regulatory capital or liquidity deficiency.²⁷ On top of that, more profitable banks might show different characteristics regarding their risk management frameworks, which additionally motivate its inclusion. The bank-specific control variables also include the growth rate of institutions' Required Liquidity (as defined by the DLCR). Although we are focussing on banks' adjustments on the asset side, it is important to also account for developments on the liability side. As explained in Section 2.3, we also include dummies for banks having DLCRs above 200% or capital ratios above 20%. Finally, we control for an institution's fulfilment of the average central bank reserve requirement.

The macroeconomic control variables include the EONIA interest rate, the GDP growth rate of the Netherlands, the government debt of the Netherlands as a percentage of GDP, as well as the relative rating of the Netherlands compared to its peers (Germany, Finland, France, Austria and Belgium). The EONIA interest rate proxies the costs of banks' alternative funding sources. If other interest rates in the economy are high, banks are more likely to buy more government bonds and vice versa.²⁸ Since the analysis only includes Dutch government bonds, the relative rating of the Netherlands compared to its peers is likely to affect banks' demand. Depending on the motivation for banks to buy a specific bond, a relatively better rating might have a positive impact (i.e. if the bank is very risk averse) or a negative impact on demand (i.e. if the bank chases high returns). The GDP growth rate is likely to capture demand effects of bank lending, which, in turn, might be funded with bond issuances or motivates banks to hold less government bonds to avoid excessive balance sheet expansion. Finally, the yield on Dutch government bonds represents the costs of government bonds. All regressions are performed with bank and

²⁷ Also see, for instance, Gennaioli et al. (2014) or Acharya and Steffen (2013).

²⁸ Also see Acharya and Steffen (2013) or Aspachs et al. (2005).

quarter dummies. The error term $\varepsilon_{i,m}$ is standard for SUR and therefore institution- and period-specific but the same across different types of bonds.

3.2. *General approach and endogeneity*

The graphical analysis suggests that on aggregate banks do not increase their government bond holdings towards the end of the month. However, since the purpose of this paper is to understand the impact of microprudential liquidity and capital regulation, it is important to distinguish banks according to their regulatory position. To analyze the impact of regulation, this paper assesses on which days of the month a bank's regulatory capital and liquidity positions have a significant impact on its net purchases of government bonds and other bonds.

The hypothesis is that if a low regulatory liquidity or capital position in month $m-1$ affects banks' demand over the entire month m , it cannot be established whether this is caused by a regulatory effect or an internal effect. If, however, a bank's demand is only affected during the last few days before reporting, there is a strong indication for the presence of a regulatory effect. The argument is that an internal decision (fully independent of regulation) would constantly and immediately affect a bank's behavior, and the exact time of purchases or sales would mainly be determined by prices. Purchases immediately before reporting by banks with low regulatory capital and liquidity levels, on the other hand, would point to a regulatory effect.

To conduct this analysis, the regression function is looped over 10 day windows, excluding weekends.²⁹ The decision to select windows of 10 days for the main regression is based on responses of banks suggesting that they monitor their regulatory ratios more

²⁹ Since microprudential liquidity and capital ratios are reported monthly, the ratios remain constant throughout a month. Banks' demand for government bonds and other bonds, however, is calculated on a daily basis and then looped over 10 day windows.

closely around 10 days before reporting.³⁰ The model is estimated 20 times with the first window spanning from day 1 to day 10 and the last window spanning from day 21 to day 30.³¹

Since this paper analyzes banks' demand for government bonds compared to other bonds, the application of Seemingly Unrelated Regressions (SUR) seems the appropriate approach.³² SUR is a system of linear equations with only exogenous regressors. The key difference to OLS is that it assumes that the errors may be correlated across equations and follow the same variance-covariance distribution. It is very likely that banks' net purchases of government bonds are partially driven by some unobserved factors, which are highly correlated to the unobserved factors driving the same banks' net purchases of other bonds. SUR allows nonzero covariance between the error terms of the equations with government bonds and other bonds as dependent variables.

While SUR seems a suitable approach for the purpose of this analysis, there are shortcomings, which need to be addressed. Firstly and similar to pooled OLS, SUR requires all explanatory variables to be exogenous. While the assumption of exogeneity is likely to hold for the macroeconomic controls, the bank-specific factors might be subject to endogeneity. To address this issue, all bank-specific variables are instrumented with their lags. Since it is implausible that an institution's net purchases of government bonds in period t affect its profitability and return on equity in $t-1$, the issue of endogeneity seems sufficiently addressed.

³⁰ We run several sensitivity tests with alternative windows and the results are qualitatively similar for shorter windows (until around 4 days) while significance decreases or diminishes for longer windows.

³¹ An alternative option is to run the model 30 times, implying that there would be windows spanning, for instance, from day 25 to 5 of the following month. However, since the capital and liquidity requirements (as well as all other variables) represent monthly figures, one would have to calculate averages over different months. Since we are interested in portfolio adjustments of banks with low capital and liquidity levels, calculating averages would make the key results significantly less precise.

³² See the seminal contribution of Zellner (1962) and a literature overview by Fiebig (2001).

A bank's capital and liquidity positions are also instrumented by their lags, since the purpose of this paper is to analyze whether a bank's capital and liquidity ratios in month $m-1$ affect its net purchases of government bonds in period m .

Another potential problem is that SUR assumes that there is no correlation of the error term across individuals. However, in case of an unobserved macroeconomic shock there would be correlation of the error terms. Although this does not make SUR a biased estimator, this issue is addressed by including time dummies that correct for these potential correlations.

In addition, the conducted Hausman tests indicate that fixed effects would be preferred over random effects as the independent variables and bank-specific effects are correlated. These results motivate the inclusion of bank dummies in our regressions.

4. Results

4.1. Liquidity buffer

Figure 5 shows that banks' regulatory liquidity position significantly affects their net purchases of government bonds. The liquidity requirement seems to cause a substitution effect with banks close to their regulatory threshold buying more government bonds while selling other bonds. Figure 5 also shows that the revision of the DLCR in May 2011, making government bonds relatively more attractive, significantly increases the observed effect.

[Insert Figure 5 here]

Figure 5 shows that banks' liquidity position determines their demand for government bonds as well as other bonds. More specifically, it can be seen that a higher DLCR in the previous period causes banks to reduce their purchases of government bonds, while

it increases their purchases of other types of bonds. This effect is in line with the previously described theory regarding the functioning of a liquidity ratio. Government bonds fully count towards the liquidity requirement while other bonds receive high haircuts. As such, when running the risk of becoming non-compliant with the requirement, banks are incentivized to substitute other bonds with government bonds.

Figure 5a presents the regression coefficients of the DLCR on banks' net purchases of government bonds. It can be seen that banks' regulatory liquidity position does not seem to affect banks' net purchases of government bonds in the first half of the following month. However, from the 21st day until the end of the month (indicated by heavy width in Figure 5a), a 1% (standard deviation) higher DLCR reduces banks' net purchases of government bonds between 0.04% (3.4%) and 0.06% (5.1%) of average purchases. On top of that, a downward slope towards the end of the month can be observed. The revision of the DLCR, leading to a general increase of haircuts but relatively less for government bonds, significantly enhances the observed regulatory effect. After the revision in May 2011, a 1% (sd) higher DLCR leads to an additional reduction of banks' net purchases of government bonds between 0.09% (8.0%) and 0.15% (13.5%).

Figure 5b shows that a bank's regulatory liquidity position in period $m-1$ does not affect its net purchases of other bonds during the first half of month m . However, from day 18 onwards banks with lower liquidity holdings seem to increase their sales of other bonds, substituting them with government bonds. Specifically, a 1% (sd) higher DLCR increases banks' net purchases of other bonds between 0.04% (3.7%) and 0.06% (5.9%). After the revision in May 2011, this effect increases further with 0.03% (2.5%) to 0.07% (6.1%) per increase of the DLCR by 1% (sd). The economic effect of the regulatory liquidity position on banks' demand for other bonds is therefore very similar to Figure 5a.

If a bank's regulatory liquidity position affects its net purchases of government bonds

over the entire month, it cannot be established whether this effect comes from regulation or from internal risk management targets. With the DLCR affecting banks' net purchases only from day 18 onwards, it can be concluded that there is limited evidence of an internal effect incentivizing banks with lower liquidity holdings to purchase more government bonds or sell more other bonds. The combined evidence of the DLCR affecting banks' demand only towards the end of the month and the slopes presented in Figure 5 show clear signs of a regulatory effect, suggesting that the DLCR incentivizes banks to substitute government bonds for other bonds. This effect is additionally confirmed by the effects caused by the revision of the DLCR in May 2011.

4.2. Capital buffer

Similar to liquidity, Figure 6 shows that the regulatory capital position is an important determinant of banks' net purchases of government bonds. One can see that a lower regulatory capital ratio in the previous month causes banks to buy considerably more government bonds and sell more other bonds.

[Insert Figure 6 here]

Figure 6a shows that a 1% (sd) higher capital ratio reduces banks' demand for government bonds between 0.44% (2.2%) and 1.17% (5.9%). Although the effect is already significant from day 11, there is a large increase immediately before reporting. This pattern suggests that a lower capital position causes an internal effect, which is significantly increased by a regulatory effect towards the end of the month. In terms of economic significance, the effect of capital regulation is similar to the effect of liquidity regulation before the revision in May 2011.

Capital regulation seems to cause a similar substitution effect to liquidity regulation.

As can be seen in Figure 6b, a 1% (sd) higher regulatory capital ratio increases banks' demand for other bonds between 0.55% (2.7%) and 0.97% (4.9%). Significant results appear from day 15 but not prior to that (indicated by heavy width in Figure 6b).

4.3. *Results for control variables*

Table 2 shows our results for the control variables. It includes information on the period in which the variables have a significant impact on banks' net purchases of government bonds, the range of the significant coefficients, as well as the standard deviation of the variable (not the results).

Banks' profitability (net income as a percentage of total assets) has a significant impact on banks' net purchases of government bonds in the first half of the month. An increase by 1sd increases banks' net purchases between 3.0% and 3.3%. The annual GDP growth rate of the Netherlands reduces banks' purchases between 1.1% and 1.2%. The variable is significant until day 26 but not afterwards. Until day 18, the government debt of the Netherlands increases banks' purchases of government bonds between 4% and 10% per increase by 1sd. The yield on Dutch government bonds is significant for almost the entire month. A 1sd increase of the yield, reduces banks' purchases of government bonds between 0.2% and 0.5%. During the first half of the month, the relative rating of the Netherlands reduces banks' purchases between 5.8% and 7.6%. Finally, the growth rate of banks' required liquidity increases their purchases of government bonds between 1.3% and 1.4%. The remaining variables do not have a significant impact on banks' purchases of government bonds.

[Insert Table 2 here]

In general terms, our results appear plausible. The intuition behind the positive effect of

an increase in banks' required liquidity on their net purchases of government bonds is straightforward. Increased liquidity risks incentivize banks to purchase more government bonds.

Similarly, it seems plausible that the purchases of Dutch government bonds increase if they are of relatively better quality (relative rating), are relatively cheaper (yield) and the supply is larger (Dutch government debt).³³ The negative effect of GDP growth on banks' purchases is likely caused by the lack of profitable investment opportunities during economic declines, leading banks to turn to government bonds. The result is also consistent with the procyclicality of risk-based capital requirements. The insignificant effect of the average reserve requirement is likely caused by the excess cash in the market and by the fact that the requirement is never binding, as discussed in Section 2.4. The insignificance of the other variables is likely caused by multicollinearity problems as, for instance, in the case of banks' return on equity, which might be captured by banks' capital and profitability.

5. Regulatory reaction and bank behavior

The previous section suggests that there is a regulatory effect that causes banks' demand for government bonds to increase beyond their internal risk management targets. While this is a useful insight, it is important to understand the potential impact of this regulatory effect on banks' lending to the private sector.³⁴

One can distinguish two ways in which government bond holdings affect credit supply.³⁵ The first one is direct and explained by Gennaioli et al. (2014): A sovereign crisis

³³ The results regarding yield could potentially be subject to reverse causality. It might be that lower demand for government bonds causes their yields to increase.

³⁴ See Gorton and Huang (2004) for a paper discussing the role of governments in liquidity provision.

³⁵ Also see Popov and van Horen (2013).

has a relatively larger negative impact on the asset value of institutions with high government bond holdings.³⁶ Losses on sovereign debt can reduce the bank's profitability and also raise concerns about counterparty risk, which in turn will have an adverse impact on the availability and cost of funding. Secondly, Holmstroem and Tirole (1993) argue that sovereign debt is usually a reliable source of liquidity and collateral. Increased sovereign risk would therefore reduce the value of an important funding source.

For their analysis, Gennaioli et al. (2014) as well as Popov and van Horen (2013), use an absolute measure of government bond holdings (e.g. government bond holdings as a percentage of total assets) and argue that regulation is a key driver of higher government bond holdings. For an analysis regarding the impact of government bond holdings on banks' lending to the real economy, it is important to distinguish banks' general government bond holdings and the regulatory reaction. Since they are all part of banks' assets and banks usually try to avoid excessive balance sheet expansions, there is a direct link between banks' bond holdings and their loan issuances. The result that high government bond holdings reduce banks' loan issuances might not be specific to government bonds. It might be the case that banks, when obtaining more bonds, generally try to reduce lending or vice versa. Similarly, since Popov and van Horen (2013) and Gennaioli et al. (2014) specifically focus on sovereign debt crises, the negative impact of government bond holdings on lending seems a logical consequence. Again, however, one might observe similar effects when analyzing other types of bonds during other types of crises. In line with the earlier analysis in this paper, we attempt to identify the impact of the regulatory effect on banks' lending as clearly as possible. Instead of using banks' stock of government bonds as a key explanatory variable, our regression function is defined as follows:

³⁶ This reduction in the value of banks' assets is likely to occur during crises and since it is equivalent to a large counterparty default straightforward in case of a government default.

$$\begin{aligned}
Lending_{i,m} = & \beta_0 + \beta_1 Estimated \Delta net purchases_{i,m} + \beta_2 Dummy_m + \beta_3 (Estimated \Delta net purchases * Dummy)_{i,m} \\
& + \beta_4 Bond holdings_{i,m-1} + \beta_5 Demand_{i,m} + \beta_6 Controls_{i,m(-1)} + \epsilon_{i,m}
\end{aligned}
\tag{4}$$

where $Lending_{i,m}$ refers to institution i 's lending to the private sector in month m as a percentage of total assets. The key explanatory variable $Estimated \Delta net purchases_{i,m}$ is based on the predicted value of the dependent variable in Equation 3. However, for this part of the analysis banks' *monthly* average net purchases are calculated. To reflect the shape and the underlying motivation of the regulatory reaction, discussed in Sections 4.1 and 4.2, we do not calculate simple averages but day-weighted averages. $Estimated \Delta net purchases_{i,m}$ are therefore defined as follows:

$$Estimated \Delta net purchases_{i,m} = \frac{\sum_{day=1}^{30} Day * Net purchases_{i,d}}{\sum_{day=1}^{30} Day}
\tag{5}$$

The motivation underlying this calculation is that a stronger regulatory effect implies higher demand towards the end of the month. Since higher net purchases towards the end of the month receive a relatively higher weight, it will lead to a stronger increase of $Estimated \Delta net purchases_{i,m}$. The variable $Estimated \Delta net purchases_{i,m}$ has a mean of 4.83 and a median of 5.74. The 25th percentile is 0.76 while the 75th percentile amounts to 12.10.

$Dummy_m$ refers to two relevant periods in our study: 1) a crisis period, and 2) the period after the revision of the DLCR. Although the entire period from June 2009 to December 2012 can be considered to be a sovereign crisis, we attempt to define an addi-

tional bank liquidity crisis within our sample. A recent study by the European Systemic Risk Board (ESRB) points to two recent periods of increased liquidity stress: 1) October 6th 2008 to February 2nd 2009, and 2) September 26th 2011 to February 8th 2012.³⁷ Since our time series does not include the first period, we define the second period as a combined banking and sovereign crisis. $Dummy_m$ is therefore either 1 during the combined crisis scenario (and 0 otherwise) or 1 after the revision of the DLCR in May 2011. $Estimated \Delta net purchases * dummy_{i,m}$ is an interaction term.

To account for banks' balance sheet restrictions, we also include banks' $Bond holdings_{i,m-1}$, defined as total bond holdings (sum of government bonds and other bonds) as a percentage of total assets. As is common in the literature, the model also includes $Demand_{i,m}$ to capture the demand side of bank lending.³⁸ $Demand_{i,m}$ is calculated as the exposure-weighted average growth rate of the economic sectors that institution i is lending to in month m .

Finally, $Controls_{i,m(-1)}$ include institutions' lagged net income as a percentage of total assets, the GDP growth rate of the Netherlands as well as the EONIA interest rate. Motivated by Hausman tests, all regressions are performed with fixed effect panel estimations.

Table 3 shows that banks' regulatory reaction is associated with lower lending volumes. There is no particular effect during the combined stress scenario, while the revision negatively affects bank lending.

[Insert Table 3 here]

³⁷ See ESRB (2014). It can also be argued that the liquidity crisis ended after ECB president Mario Draghi's speech on July 26th 2012 in London. Defining the crisis period that way does not lead to significantly different results.

³⁸ See, for instance, Popov and van Horen (2013) as well as Brown et al. (2010), Fabbro and Hack (2011) or Deans and Stewart (2012).

An increase of *Estimated Δ net purchases* by 1sd reduces banks' credit supply between 12.9% (Column 1) and 13.6% (Column 3).³⁹ Apart from being statistically significant at the 1% confidence interval, the variable is also economically significant. Since banks' government bond purchases increase the asset side of their balance sheet and banks usually try to avoid excessive balance sheet expansion, it appears logical to reduce lending when buying more government bonds. The fact that loans usually have relatively high RW and no liquidity value is an additional incentive for banks to reduce lending when reacting to regulation.

Crisis does not have a significant impact on lending. This effect is likely caused by the relatively short time period of this combined scenario and the fact that the entire period can be defined as a crisis. The *Revision* of the DLCR, on the other hand, reduces lending by 3.1% (1% confidence interval). The interaction term *Estimated Δ net purchases * revision* does not affect bank lending. The *Revision* caused government bonds to be relatively more attractive and increased banks' net purchases. It seems therefore plausible that the *Revision* reduced lending. However, there does not seem to be a reason why higher net purchases should have an additional effect after the *Revision*, justifying the insignificance of the interaction term.

Other variables worth mentioning are *Total bonds* and *Demand*. An increase of *Total bonds* by 1sd reduces banks' lending by about 6%. This result is in line with our expectations. Higher bond holdings reduce the leeway to grant large amounts of loans while bonds are usually more profitable than most types of lending, at least during stress. A 1sd increase of *Demand* increases bank lending by about 4%.

Although different, our results regarding lending are related to Gennaioli et al. (2014)

³⁹ As a sensitivity test, we also used the growth rate of bank lending as dependent variable. The results are qualitatively similar.

and Popov and van Horen (2013). However, while these two studies focus on failed or nearly failed governments, the banks in the present analysis only buy Dutch government bonds. The results in this section raise the question whether it is desirable that regulation incentivizes banks to buy more government bonds since it seems to be associated with less lending.

6. Shortcomings

Although this is one of the first studies attempting to directly estimate the impact of capital and liquidity regulation on banks' demand for government bonds and its subsequent impact on bank lending, a few caveats are in order.

As the MiFID data only includes Dutch government bonds, the time series does not include a rating downgrade. However, the Netherlands was put on "negative watch" a few times during this paper's sample period, allowing to at least partially control for the impact of downgrades. Additionally, all regressions include the relative rating of the Netherlands compared to its peers (Germany, France, Belgium, Finland and Austria), which can be expected to additionally account for these dynamics.

As the analysis combines two datasets with different means of consolidation, there is a risk of a measurement bias.⁴⁰ To address this bias and although it implies dropping parts of the dataset, the analysis excludes all entities that do not belong to a Dutch group. Since there is more detailed information on the Dutch entities, it is possible to match the different datasets minimizing a measurement bias.

The analysis in this paper aims at capturing the impact of preferential treatment on banks' demand for government bonds and, in a second step, its impact on bank lending.

⁴⁰ The MiFID database is reported on a solo level while the bank-specific supervisory data refers to the fully consolidated balance sheet.

Although the paper includes a clear link to the real economy, it remains a partial analysis. To draw firm policy conclusions one would need to more broadly account for the impact of increased government spending on the economy as a whole.

7. Conclusion

Government bonds receive preferential treatment in financial regulation. The purpose of this paper is to analyze whether this preferential treatment increases banks' demand for government bonds beyond their own risk appetite, leading banks to substitute other types of bonds with government bonds. The final step of our analysis aims at capturing the impact of this regulatory effect on banks' lending to the real economy.

Our results suggest that preferential treatment in microprudential capital and liquidity regulation increases banks' demand for government bonds. On top of that, it seems to cause a substitution effect, with banks buying more government bonds while selling more other bonds. Further, we find suggestive evidence that this "regulatory reaction" reduces banks' lending.

The rationale behind favorable treatment in financial regulation is the view that government bonds are risk-free assets, making them a reliable source of liquidity and collateral. The European sovereign debt crisis, however, has exposed the risk of vicious circles between fragile governments and weak banks. While this paper does not answer the question whether high government bond holdings are desirable (or under which circumstances), it shows that if there is a desire to avoid these vicious circles in the future, removing the preferential treatment of government bonds in financial regulation appears to be a good starting point.

Appendix

MiFID data cleaning and construction

MiFID requires institutions to report transactions per entity as opposed to the full consolidation of the balance sheet information. A first step of the data construction is therefore to identify those entities that belong to the same group. This is done using the publicly available SWIFT codes. To ensure as clear identification as possible, we only retain those transactions in which both counterparts can be identified as banks and at least one of the two consolidated counterparts is a Dutch bank. The sample rule deletes 43,297 transactions, amounting to 7.8% (5.4%) of total transactions (volume). The majority of the deleted transactions are trades between entities of British banks. This approach ensures that all considered transactions are executed by a bank subject to prudential regulation of DNB, which causes 17 banks to remain in the dataset.

The MiFID transaction reports also indicate whether a bank acted as "Principal" or "Agent". Acting as "Agent" implies that the bank acts on behalf of clients and therefore never takes ownership of the instrument, while a principal transaction refers to a bank acting on its own behalf. Since they are not relevant for the fulfilment of regulatory requirements, all agent transactions are dropped. We also clean the data following the same procedure as Dick-Nielsen et al. (2012). Specifically, the analysis corrects for double reporting, which occurs when both institutions are EU financial institutions, erroneous reporting of counterpart codes and banks' reporting of (reverse) repos which should not be reported in MiFID.

The average reserve requirement

Most central banks - among which the European Central Bank (ECB) - require credit institutions to hold a minimum amount of reserves with them. An institution's reserve

requirement is determined by multiplying the reserve base with the reserve ratio. The reserve base includes retail deposits and a selection of short-term liabilities, while the ECB's reserve ratio is currently set at 1%.⁴¹ Compliance with minimum reserve requirements is determined on the basis of banks' average daily balances on the central bank reserve accounts over the reserve maintenance period. The main function of the minimum reserve requirement is to stabilize money market rates.

⁴¹ The ECB reserve ratio was reduced from previously 2% to 1% on January 18th 2012.

Comparison of liquidity standards DLCR and LCR

Comparison liquidity requirements

Haircuts on liquid assets	DLCR	LCR
Cash	0%	0%
Central bank reserves	0%	0%
Government bonds	5% (10%)	0%
Covered bonds	20%	15%
Corporate bonds	20% (50%)	15%-50%
Securitizations	20% (50%)	25%
Inflows rates		
Retail loans	50%	50%
Interbank loans	100%	100%
Outflow rates		
Retail deposits	10%-20%	3%-10%
Corporate deposits	50%-100%	40%-75%
Interbank deposits	100%	100%

Note: The table shows a comparison of the Dutch and the Basel III liquidity requirements. Numbers in brackets refer to haircuts after the DLCR's revision in May 2011. The description is highly simplified. For more information, please see BCBS (2013) and DNB (2003) or De Haan and van den End (2013).

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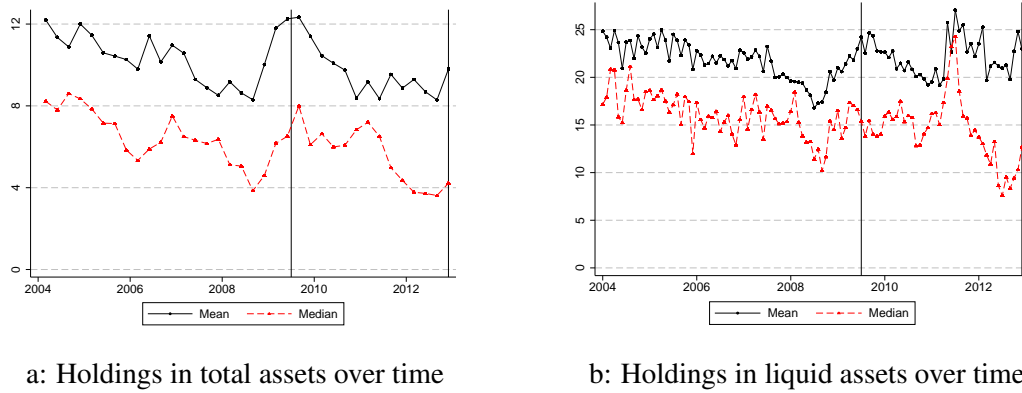
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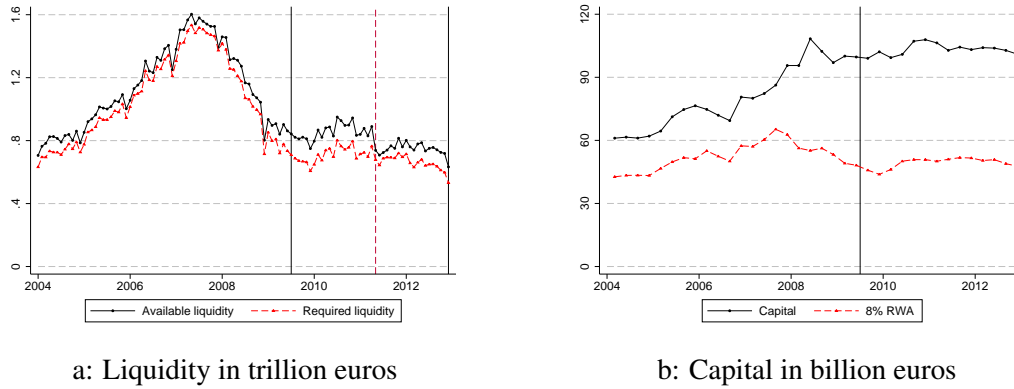
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Figure 1: Banks' holdings of government bonds from 2004 to 2012



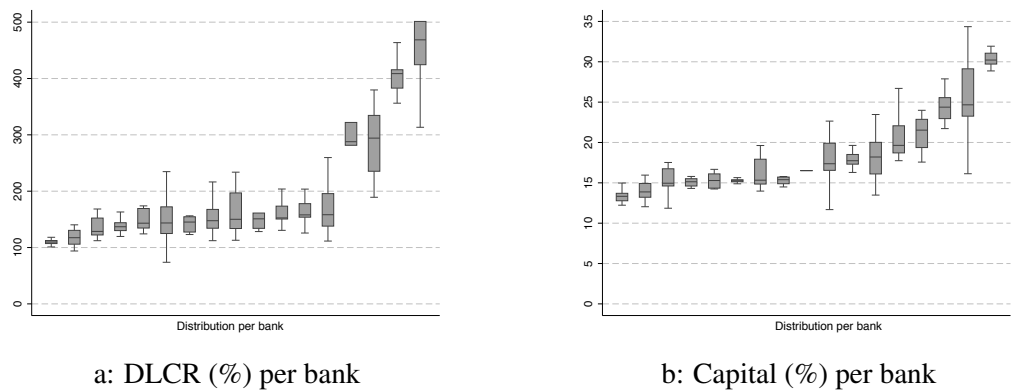
Note: The figure shows banks' average and median holdings of government bonds with 0% risk weights under the Basel II Standardized Approach as a percentage of total assets (Figure 1a) and liquid assets as defined by the DLCR (Figure 1b). The vertical lines represent the start (June 2009) and end date (December 2012) of the MiFID dataset.

Figure 2: Capital and liquidity, 2004-2012



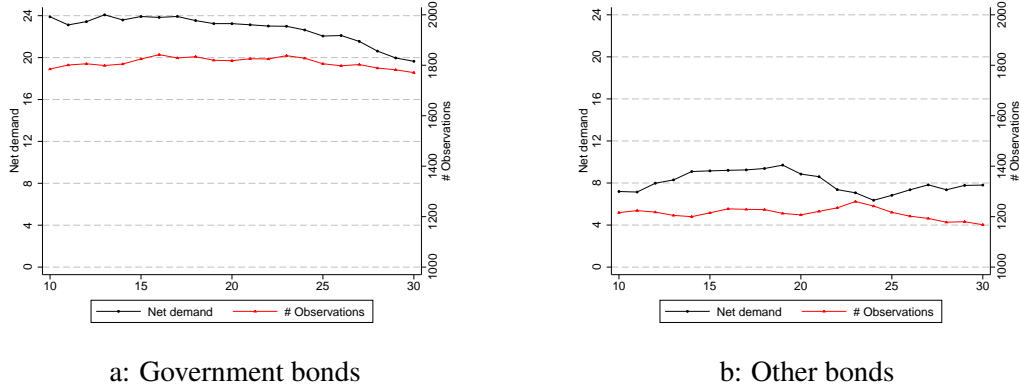
Note: The figure shows the components of the aggregate liquidity and capital requirements from 2004 to 2012. The solid vertical lines mark the start and end date of the MiFID dataset used for the regression analysis. The dashed line in Figure 2a marks the revision of the liquidity rule in May 2011.

Figure 3: Capital and liquidity per bank, 2009-2012



Note: The figure shows the distribution of the DLCR and capital requirement per bank over the period from June 2009 to December 2012.

Figure 4: Banks' net purchases of Dutch government bonds and other bonds



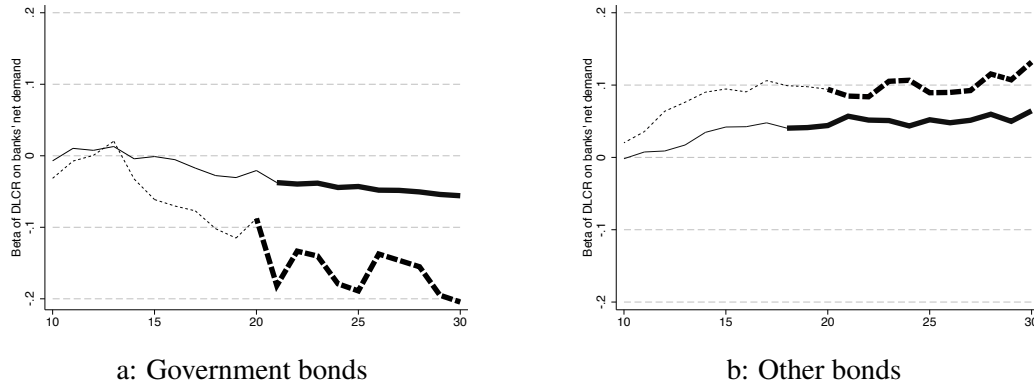
Note: The figure shows banks' net purchases of Dutch government bonds (Figure 5a) and other bonds (Figure 5b) over windows consisting of 10 days, as well as the corresponding number of observations. Banks' net purchases are calculated as the average of the difference between institutions' gross purchases and gross sales of bond b (government bond or other bonds) in percentage of their average daily gross purchases during the year. The number of observations corresponds with the total number of trades executed by banks that are active as a buyer or a seller at least once every day. Day 12, for instance, refers to banks' average net purchases between day 3 and day 12.

Table 1: Summary statistics

Variable	Obs.	Mean	Std.Dev.	Min	Max
Dependent variables					
Net purchases of government bonds	3,520	22	25	-61	123
Net purchases of other bonds	2,890	8	42	-98	152
Key explanatory variables					
Liquidity buffer	527	151	91	-26	416
Capital buffer	527	10	5	-0.09	32
Control variables					
Average reserve requirement	3,520	115	42	35	399
Net income as a % total assets	527	1.23	0.74	-1	5
Net income as a % total capital	527	1.92	4	-18	17
Total assets (ln)	527	22	25	-61	123
Private sector lending as a % total assets	527	39	13	12	62
Total bond holdings as a % total assets	527	10	9	2	48
Demand	527	-0.19	1.64	-3	3
EONIA	11	0.49	0.28	0.07	1
Quarterly GDP growth rate (%) of the Netherlands	11	0.06	0.37	-1.42	0.99
Quarterly government debt as a % GDP	11	55	2	49	57
Quarterly NL rating over average peers' rating	11	0.77	0.06	0.68	0.83
Quarterly yield on Dutch government bonds	11	0.02	0.008	-0.96	0.16

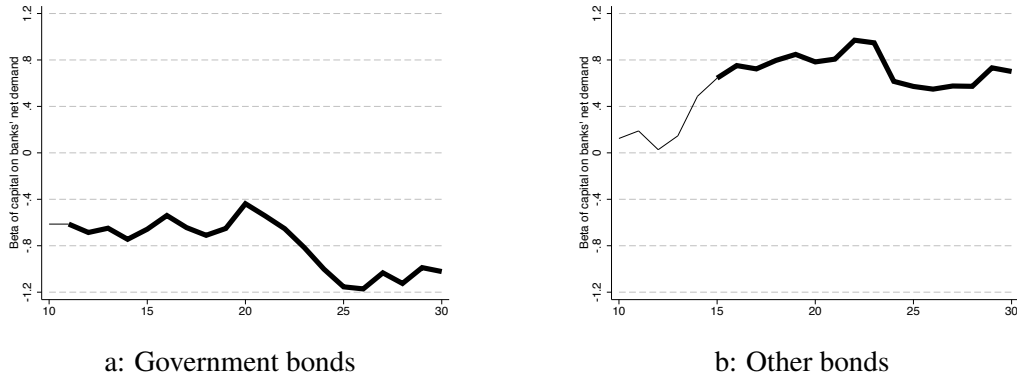
Note: The table shows summary statistics for all relevant variables. The number of observations refers to unique observations. This means, for instance, that the macroeconomic variables only show one observation per month for the period from June 2009 to December 2012.

Figure 5: Impact of regulatory liquidity buffers on banks' daily net purchases



Note: The figure presents the results obtained using SUR before (solid line) and after (dashed) the revision of the DLCR in May 2011 (reflected by the sum of the coefficients before and after the revision). The analysis aims at explaining the impact of banks' regulatory liquidity position on their demand for government bonds and other bonds. The dependent variable reflects the difference between institution i 's gross purchases and gross sales of bond b (government bond or other bonds) on day d as a percentage of its average daily gross purchases of bond b during the year. Apart from the presented coefficients for the DLCR (distance of an institution's DLCR to the 100% regulatory threshold), all regressions include Capital, as well as a large number of additional control variables. The regressions are looped over windows consisting of 10 days over the course of the month, plotted on the x-axis in the figure. For instance, on day 13 one can see the coefficient of regressing the DLCR in month $m-1$ on banks' daily net purchases during day 4 to 13 of month m . Heavy width represents statistically significant values, while normal width points to insignificance. The differences of the DLCR's statistical significance at the beginning and the end of the month are statistically significant at the 95% confidence level (F-test).

Figure 6: Impact of regulatory capital buffers on banks' daily demand



Note: The figure presents results obtained using SUR. The analysis aims at explaining the impact of banks' regulatory capital position on their net purchases of government bonds and other bonds. The dependent variable reflects the difference between institution i 's gross purchases and gross sales of bond b (government bond or other bonds) on day d as a percentage of its average daily gross purchases of bond b during the year. Apart from the presented coefficients for Capital (distance of an institution's regulatory capital holdings to the 8% threshold), all regressions include the DLCR, as well as a large number of additional control variables. The regressions are looped over windows consisting of 10 days over the course of the month, plotted on the x-axis. On day 10 one can see the coefficient of regressing Capital in month $m-1$ on banks' daily net purchases from day 1 to 10 of month m . Heavy width represents statistically significant values while normal width points to insignificance. The differences of the DLCR's statistical significance at the beginning and the end of the month are statistically significant at the 95% confidence level (F-test).

Table 2: Results control variables

Variable	Significant days government bonds	Coefficients government bonds	Std.Dev.
Liquidity buffer	21-30	-0.06 to -0.04	91
Liquidity buffer*revision	20-30	-0.15 to -0.09	81
Capital buffer	11-30	-1.17 to -0.44	5
Net income as a % total assets	1-14	4.0 to 4.3	0.74
GDP growth rate NL	1-26	-3.0 to -3.3	0.37
Government debt as a % GDP	1-18	2 to 5	2
Yield on Dutch government bonds	11-30	-68 to -30	0.008
NL rating over average peers' rating	1-18	-127 to -97	0.06
Growth rate of Required Liquidity	15-18	-0.08 to -0.09	16
Average reserve requirement	-	-	42
Private sector lending as a % total assets	-	-	39
Net income as a % total capital	-	-	4
EONIA	-	-	0.49

Note: The table shows the summary of the results for our control variables. It includes information on the period in which the variables significantly impact banks' purchases of government bonds, the range of the significant coefficients, as well as the standard deviation of the variable (not the result). A dash indicates that the variable has no significant coefficients.

Table 3: Government bonds and lending

	1	2	3
Estimated Δ net purchases	-0.300*** (0.085)	-0.310*** (0.086)	-0.316*** (0.094)
Estimated Δ net purchases * crisis		-0.333 (1.139)	
Crisis		-1.705 (4.698)	
Estimated Δ net purchases * revision			-0.125 (0.140)
Revision			-3.114*** (1.038)
Total bonds (lagged)	0.631*** (0.151)	0.603*** (0.164)	0.511*** (0.184)
Return on equity (lagged)	-0.131 (0.125)	-0.151 (0.132)	-0.146 (0.131)
Demand	2.138** (0.822)	2.603** (1.041)	2.494*** (1.088)
GDP NL	-0.715 (1.059)	-1.057 (1.177)	-0.814 (1.011)
EONIA	-7.051* (3.448)	-7.948** (3.725)	-6.941** (3.832)
Constant	47.562*** (2.995)	48.796*** (3.501)	44.654*** (3.981)
Observations	234	234	234
R^2	0.835	0.839	0.775

Note: The table presents results of regressions estimated with fixed effect panel estimations including lagged variables and robust standard errors. The dependent variable is banks' lending to the private sector. *Estimated Δ net purchases* is the day-weighted average net portfolio adjustment for government bonds. *Crisis* is a dummy, which is 1 for the period from September 2011 to February 2012 and 0 otherwise, while *Revision* is a dummy describing the period after the revision of the DLCR in May 2011. *Total bonds* is defined as banks' total bond holdings (sum of government bonds and other bonds) as a percentage of total assets, while *Return on Equity* describes banks' net income as a % of total capital. *Demand* is calculated as the exposure weighted average growth rate of the economic sectors an institution is lending to. Finally *GDP NL* refers to the quarterly growth rate of the Netherlands, while *EONIA* describes the EONIA interest rate. Statistical significance is indicated by *** p<0.01, ** p<0.05, * p<0.1 while standard errors are in parentheses.